PATENT ABSTRACTS OF JAPAN

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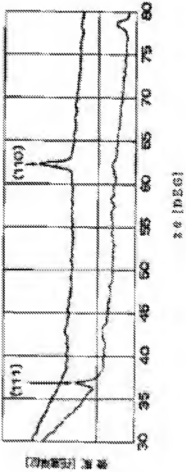
(54) PLASMA DISPLAY PANEL

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance sputtering resistance of a protective film by arranging a magnesium oxide film of a 110 orientation.

SOLUTION: An MgO film of a 110 orientation is formed as a protective film on a surface of a dielectric layer of PbO type low melting point glass of a plasma display panel. A glass substrate on which a sustained electrode and the dielectric layer are formed is fixed in an evaporation device chamber, and as one example, oxygen partial pressure is kept in 1×10-4Torr, and steam partial pressure is kept in a constant value, and evaporation is performed. Hydrogen gas and oxygen gas are introduced, and for example, the steam partial pressure is set in a range not more than 5×10-4Torr, and the 110 orientation is enhanced according to an increase in the steam partial pressure exceeding 1×10-4Torr. When the membrane of the MgO film formed into the dielectric layer is taken as 110 orientation, a membrane close to high density bulk is obtained, and sputtering resistance can be enhanced.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to an AC type plasma display panel (PDP). In recent years, since PDP is suitable for animation display rather than the liquid crystal device, it has come to be conjointly used widely for the use of the Television Sub-Division image, a monitor of a computer, etc. with the color screen having been put in practical use. It is observed as a big screen flat type device for Hi-Vision. In such a situation, improvement in performances, such as reduction and reinforcement of high-definition-izing and power consumption, is advanced.
[0002]
[Description of the Prior Art]In AC type PDP, the electrode of the couple for discharge is covered with dielectric layers, such as low melting glass, and the heat-resistant protective film for protecting from the ion bombardment at the time of discharge on the surface of a dielectric layer further is provided. Since a protective film touches discharge space, it has influence to a discharge characteristic with the big construction material and membraneous quality. Generally, magnesium oxide (MgO: magnesia) is used as a protective coat material. MgO is a metallic oxide with a large secondary emission coefficient, by using this, firing potential falls and a drive becomes facilitating.
[0003]In MgO, a secondary emission coefficient has some differences by crystal orientation. In the case of orientation (111), it is widely known for the measurement using the bulk (substrate) which started the monocrystal ingot of MgO that a secondary emission coefficient is the largest. Then, in the conventional PDP, the MgO film of orientation (111) about 1 micrometer thick was formed on the surface of the dielectric layer by the vacuum deposition method. Vacuum deposition is excellent in respect of productivity and membraneous quality compared with other membrane formation techniques (spraying of organic acid metal salt, spreading of impalpable powder, etc.).
[0004]
[Problem(s) to be Solved by the Invention]The life of 10000 hours is realized by covering a dielectric layer with the MgO film of orientation (111) about 1 micrometer thick as mentioned above. However, the longer one of a life is desirable. Since an ion bombardment will increase with reduction of a discharge gap if it tries to attain highly minute-ization, advance of the weld slag of a MgO film will speed up, and a life will become short. If a MgO film can be shaved and a dielectric layer is exposed, firing potential will rise substantially and will become drive impossible. If thickness is increased in order to prolong a life, it will become easy to generate a crack.

[0005]This invention improves the weld slag-proof nature of the protective film of a dielectric layer, and an object of this invention is to attain reinforcement.

[0006]

[Means for Solving the Problem]An orienting film (110) is [in / for a chief aim / not a secondary emission coefficient but weld slag-proof nature] superior to an orienting film (111). In a direction of a field (110), in a crystal structure (Na-Cl type) of MgO, channeling happens easilier than a field (111). That is, incidence ion goes into an inside of a crystal easily deeply, and weld slag near surface does not happen easily. It turned out that density becomes the high membraneous quality near bulk, so that orientation (110) became remarkable rather than a case where it is orientation (111), when membraneous quality of a MgO film which actually formed membranes on a dielectric layer was investigated. Weld slag-proof nature is so high that it is precise.

[0007]It comes to provide a MgO (magnesium oxide) film of orientation (110) as a surface-protection film of a dielectric layer in which PDP of an invention of Claim 1 covers a display electrode. Here, a MgO film of orientation (110) is a film from which an orientation (110) crystal (a field parallel to a film flat surface is a crystal of {111} sides) became superior on the number to other crystals, and it is formed of high frequency ion plating in inside of atmosphere of suitable oxygen tension and a steam partial pressure, etc.

[0008]

[Embodiment of the Invention]Drawing 1 is an exploded perspective view showing the internal structure of PDP1 concerning this invention. PDP1 of illustration is AC type PDP of plane discharge form. Sustaining electrode [of a couple] X and Y are arranged for every line of a matrix display by the inner surface of the glass substrate 11 by the side of a front face. Each consists of the transparent conducting film 41 and the metal membrane 42, and sustaining electrode X and Y are covered with the dielectric layer 17 whose thickness for AC drive is about 50 micrometers to the discharge space 30. The material of the dielectric layer 17 is PbO system low melting glass. The MgO film of the orientation (110) about 1 micrometer thick as the protective film 18 is formed in the surface of the dielectric layer 17. On the other hand, the fluorescent substance layers 28R, 28G, and 28B of three colors (R, G, B) for address electrode A, the septum 29, and a colored presentation are formed in the inner surface of the glass substrate 21 by the side of the back. The discharge space 30 is divided for every subpixel EU by the septum 29 in a line direction, and the gap size of the discharge space 30 is specified to constant value. The discharge space 30 is filled up with the penning gas which mixed a small amount of xenons to neon.

[0009]It consists of the three subpixel EU of a display to which 1 pixel (pixel) of EG(s) are located in a line with a line direction. Since the arrangement pattern of the septum 29 is a stripe pattern, the portion corresponding to each sequence of the discharge space 30 is following the column direction ranging over all the lines. The luminescent color of the subpixel EU within each sequence is the same. In PDP1, address electrode A and sustaining electrode Y are used for selection (addressing) of lighting (luminescence) / astigmatism light of the subpixel EU. That is, a screen scan is performed to line sequential and a predetermined electrification state is formed by discharge between sustaining electrode Y and address electrode A selected according to display information. After addressing, if the sustained pulse of predetermined peak value is impressed to sustaining electrode Y and the sustaining electrode X by turns, the plane discharge along a substrates face will arise in the cell in which it is at the end time of addressing, and the wall charge of the specified quantity existed. The fluorescent substance layers 28R, 28G, and 28B are locally excited by the ultraviolet rays generated in plane discharge, and light is

emitted. The visible light which emits light by the fluorescent substance layers 28R, 28G, and 28B, and penetrates the glass substrate 11 turns into display light.
[0010]Drawing 2 is a figure showing orientation distribution of a protective film. In PDP1, the orienting film (110) excellent in weld slag-proof nature is provided in the advantageous MgO film on low-pressure-izing of firing potential as the protective film 18 of the dielectric layer 17 as mentioned above. The solid line in drawing 2 shows the result of analysis by the X-ray diffractometer to the protective film 18, and the broken chain line shows the result of analysis of a conventional example. In the protective film 18 of this embodiment, when 2 theta (angle of diffraction) is about 63 degrees, a peak remarkable in diffraction intensity is seen, and it turns out that the protective film 18 is an orienting film (110) so that clearly from a figure.
[0011]PDP1 of the above structure is manufactured through the process of establishing a predetermined component separately about each glass substrates 11 and 21, the process of carrying out the placed opposite of the glass substrates 11 and 21, and closing the circumference, the process of enclosing discharge gas, etc. In that case, the protective film 18 is formed at the glass substrate 11 side by the vacuum deposition (the high frequency ion plating method) which generates plasma, for example within a chamber. Hereafter, the example of the formation method of the protective film 18 is explained.
[0012]
[Example]The evaporation apparatus provided with an electron-beam-heating type evaporation source and a 13.56-MHz RF generator is used. The glass substrate 11 in which sustaining electrode X, Y, and the dielectric layer 17 were formed is fixed in a chamber.
[0013]After exhausting until it reached degree-of-vacuum $7x10^{-7}$Torr, oxygen tension was maintained at $1x10^{-4}$Torr, and it vapor-deposited by maintaining a steam partial pressure at the constant value of $1x10^{-5}$ - $1x10^{-3}$Torr within the limits. Setting out of the steam partial pressure was performed by introducing hydrogen gas and oxygen gas. Substrate temperature was 250 ** and high-frequency power was 1 kW.
[0014]Drawing 3 is a graph which shows the relation between a steam partial pressure and the crystal orientation of a MgO film. The vertical axis of drawing 3 shows the size of the intensity (peak intensity) of the diffracted light of each crystal orientation in an X diffraction.
[0015]In the range below $5x10^{-4}$Torr, a stacking tendency increases as a steam partial pressure increases (110). If $1x10^{-4}$Torr is exceeded especially, a stacking tendency (111) will fall rapidly and a stacking tendency will increase rapidly conversely (110). In $5x10^{-4}$Torr, it becomes a nearly perfect (110) orienting film. If a steam partial pressure exceeds $5x10^{-4}$Torr, plasma will stop occurring due to the fall of a degree of vacuum, and a crystal will become difficult to grow. Also when oxygen tension was set to $3x10^{-4}$Torr, the stacking tendency (110) increased with the increase in a steam partial pressure. (110) In order to obtain an orienting film, it is desirable for total pressure to set a steam partial pressure or more [of oxygen tension] to 1/2 within limits which do not exceed a maximum.
[0016]Next, evaluation of weld slag-proof nature is explained. Only the steam partial pressure was changed among film formation conditions, MgO was vapor-deposited to the soda lime glass piece of the 2-cm angle which ground the surface, and several samples from which a stacking tendency differs were produced. Some MgO films of each sample were covered with the mask, and ion etching (source gas: Ar, accelerating voltage:200V) was performed to the exposed MgO film. And the level difference of an etching portion and a masking portion was measured by the thickness gage (accuracy of **100A). The result is shown in Table 1. The intensity (peak intensity) in Table 1 is the value of standard which set

intensity of the orientation (110) of the sample 6 to 100. In order to secure the surface smoothness of a film formation surface, the soda lime glass piece was used as a substrate, but as a ground of membrane formation, it is almost same between a dielectric layer (low melting glass) and soda lime glass.

[0017]

[Table 1]

試料番号	水蒸気分圧 [Torr]	(111)の強度 [規格値]	(110)の強度 [規格値]	スパッタ量 [Å]
0	0（従来例）	50	0	1000
1	1×10^{-5}	50	0	980
2	2×10^{-5}	48	0	950
3	5×10^{-5}	53	4	940
4	1×10^{-4}	55	11	930
5	2×10^{-4}	50	60	690
6	5×10^{-4}	0	100	480
7	1×10^{-3}	0	45	760

[0018](110) It turns out that the amount of weld slag (etched depth) is excellent in weld slag-proof nature few, so that orientation is remarkable. In an above-mentioned embodiment, although plane discharge type PDP1 was illustrated, this invention is applicable also to opposite discharge type PDP. The formation method of the MgO film of the orientation (110) as the protective film 18 is not limited to the method of illustration.

[0019]

[Effect of the Invention]According to the invention of Claim 1, the weld slag-proof nature of the protective film of a dielectric layer can be improved, and reinforcement can be attained.

[Translation done.]